

410 Rec'd PCT/PTO 11 JAN 1999

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|---|---|---|------------------------|
| FORM PTO-1390   |   | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE   | Attorney's Docket No.: |
| <b>TRANSMITTAL LETTER TO THE UNITED STATES<br/>DESIGNATED/ELECTED OFFICE (DO/EO/US)<br/>CONCERNING A FILING UNDER 35 U.S.C. 371</b>   |   |   | <b>XI/P6217USO</b>     |
|   |   |   | U.S. Appln. No.:       |
| INTERNATIONAL APPLICATION NO.<br>PCT/JP97/02369   | INTERNATIONAL FILING DATE<br>09 JULY 1997 | PRIORITY DATE CLAIMED<br>10 JULY 1985<br><b>09/214708</b> |                        |
| Title of Invention<br>CLEANING GAS  |   |   |                        |
| Applicant(s) for DO/EO/US<br>ITANO, Mitsushi  |   |   |                        |
| Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:   |   |   |                        |
| <p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SEBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19<sup>th</sup> month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A <b>copy</b> of the International Application as filed (35 U.S.C. 371 (c)(2))</p> <p style="margin-left: 20px;">a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p style="margin-left: 20px;">b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</p> <p style="margin-left: 20px;">c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</p> <p>6. <input checked="" type="checkbox"/> A <b>translation</b> of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))</p> <p style="margin-left: 20px;">a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p style="margin-left: 20px;">b. <input type="checkbox"/> have been transmitted by the International Bureau.</p> <p style="margin-left: 20px;">c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments had NOT expired.</p> <p style="margin-left: 20px;">d. <input checked="" type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An <b>oath</b> or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p><b>Items 11. To 16. Below concern document(s) or information included:</b></p> <p>11. <input type="checkbox"/> An <b>Information Disclosure Statement</b> under 37 C.F.R. 1.97 and 1.98.</p> <p>12. <input checked="" type="checkbox"/> An <b>Assignment</b> document for recording. A separate cover sheet in compliance with 37 C.F.R. 2.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A <b>First preliminary amendment</b>.</p> <p style="margin-left: 20px;"><input type="checkbox"/> A Second or subsequent preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input type="checkbox"/> Other:</p> <p style="margin-left: 20px;"><input type="checkbox"/> Small Entity Statement</p> <p style="margin-left: 20px;"><input type="checkbox"/> Customer Number/Change of Address</p> <p style="margin-left: 20px;"><input type="checkbox"/></p> <p><input type="checkbox"/> A copy of the Notification of Missing Requirements under 35 U.S.C. 371.</p> <p><input type="checkbox"/> In the event that a petition for extension of time is required to be submitted herewith, and in the event that a separate petition does not accompany this response, applicant hereby petitions under 37 CFR 1.136(a) for an extension of time of as many months as are required to render this submission timely. Any fee is authorized in 17(c).</p> |   |   |                        |
| Date: 11 January 1999   |   |   |                        |

|   |   |                                       |
|---|---|---------------------------------------|
| U.S. Application No. (if known, see 37 CFR 1.5) | International Application No.<br>PCT/IP97/02369 | Attorney's Docket No.:<br>XI/P6217USO |
|---|---|---------------------------------------|

17. ☒ The following fees are submitted:

**Basic National Fee** (37 CFR 1.492 (a) (1)-(5);

☒ Search Report has been prepared by the EPO or JPO ..... \$ 840.00

☐ International preliminary examination fee paid to USPTO ..... \$ 670.00

☐ No Int'l Prelim. Exam. fee paid to USPTO but Int'l Search fee paid to USPTO ..... \$ 760.00

☐ Neither Int'l Prelim. Exam. fee nor Int'l Search fee paid to USPTO ..... \$ 970.00

☐ Int'l Prelim. Exam. fee paid to USPTO & all claims satisfied PCT Art. 33(2)-(4) ..... \$ 96.00

**ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 840.00**

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 mos. ☐ 30 mos.  
from the earliest claimed priority date (37 CFR 1.492(e)).

| Claims                                      | Number filed | Number extra | Rate       |                  |  |
|---|--------------|--------------|------------|------------------|--|
| Total claims                                | 10- 20 =     |              | X \$ 18.00 | \$               |  |
| Independent claims                          | 02- 03 =     |              | X \$ 78.00 | \$               |  |
| Multiple Dependent Claim(s) (if applicable) |              |              | + \$260.00 | \$               |  |
| <b>TOTAL OF ABOVE CALCULATIONS =</b>        |              |              |            | <b>\$ 840.00</b> |  |

Reduction of 1/2 for filing by **small** entity, if applicable. Small Entity Statement must also be filed. \$

**SUBTOTAL = \$ 840.00**

Processing fee of \$130.00 for furnishing the **English translation** later than ☐ 20 mos. ☐ 30 mos.  
From the earliest claimed priority date (37 CFR 1.492(f)). + \$

**TOTAL NATIONAL FEE = \$ 840.00**

Fee for recording the enclosed **assignment**, accompanied by a cover sheet \$40.00 per property + \$ 40.00

**TOTAL FEES ENCLOSED = \$ 880.00**

|  |               |    |
|--|---------------|----|
|  | Amount to be: | \$ |
|  | Refunded      |    |
|  | Charged       | \$ |

Calculations - PTO use only

a. ☒ A **check** in the amount of \$880.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 12-0555 in the amount of \$\_\_\_\_\_ to cover the above fees.

c. ☒ The Commissioner is hereby authorized to charge any additional fees required or credit overpayment to Deposit Account No. 12-0555.

**Note:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b) must be filed and granted to restore the application to pending status.

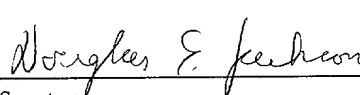
  

Please address all correspondence to Thomas P. Sarro at the address (below) of **Customer Number: 000881**.

SEND ALL CORRESPONDENCE TO:

**Larson & Taylor**  
Transpotomac Plaza  
1199 North Fairfax Street, Suite 900  
Alexandria, Virginia 22314-1437

  
 \_\_\_\_\_  
 Signature

Name: Douglas E. Jackson  
Registration: 28518

**Date: 11 January 1999**

09/214708

300 Rec'd PCT/FTG

11 JAN 1999

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of ITANO, M. )  
New Application ) Atty's Dckt: X/P6217US0  
Filed: On even date herewith ) Application Branch  
For: CLEANING GAS )

PRELIMINARY AMENDMENT

Hon. Assistant Commissioner of Patents  
Washington, D.C. 20231

S I R:

Preliminary to the examination thereof, please amend the above-identified application as follows:

IN THE CLAIMS:

Claim 5, lines 1 and 2, delete "any one of claims 1-4", and insert therefor --claim 1--.

Claim 10, lines 1 and 2, delete "any one of claims 6-9", and insert therefor --claim 6--.

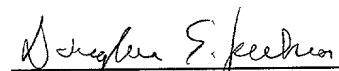
REMARKS

The above amendments are being made in order to place the application in better condition for examination and to reduce the filing fee.

Favorable consideration is respectfully requested.

Respectfully submitted,

Date: January 11, 1999

  
By: Douglas E. Jackson  
Registration No. 28518

**LARSON & TAYLOR**

1199 North Fairfax Street, Ste. 900 • Alexandria, Virginia 22314 • (703) 739-4900

-1-

## DESCRIPTION

CLEANING GASTECHNICAL FIELD

The present invention relates to a cleaning gas  
5 suitable for use in production of semiconductors.

BACKGROUND ART

Perfluoro compounds such as  $CF_4$ ,  $C_2F_6$ ,  $C_4F_8$   
(perfluorocyclobutane) and  $SF_6$  are used in large amounts  
as cleaning gases for plasma CVD chambers in production  
10 of semiconductors. Since the perfluoro compounds are  
stable and have long atmospheric lifetimes and high  
infrared absorbency, they have extremely high global  
warming potential (GWP) as compared with carbonic acid  
gas.  $CF_4$  is 6300 times,  $C_2F_6$  is 1250 times,  $C_4F_8$  is 9100  
15 times and  $SF_6$  is 24900 times as high as carbonic acid gas  
in GWP. Therefore, development of a substitute gas  
having a low global warming potential is an urgent task.

An object of this invention is to provide a  
substitute gas which is suitable for use as a cleaning  
20 gas for plasma CVD chambers in production of  
semiconductors, the gas having a low global warming  
effect.

DISCLOSURE OF INVENTION

The present invention provides the following  
25 cleaning gas and cleaning method:

1. A chamber cleaning gas comprising at least one gas selected from the group consisting of  $\text{CF}_3\text{CF}=\text{CF}_2$ ,  $\text{CF}_3\text{CF}-\text{CF}_2$  and  $\text{CF}_3\text{C}=\text{O}$ .

2. A chamber cleaning method comprising cleaning a plasma CVD chamber of a semiconductor integrated circuit production device using at least one gas selected from the group consisting of  $\text{CF}_3\text{CF}=\text{CF}_2$ ,  $\text{CF}_3\text{CF}-\text{CF}_2$  and  $\text{CF}_3\text{C}=\text{O}$ .

As the chamber cleaning gas of the invention, any of  $\text{CF}_3\text{CF}=\text{CF}_2$ ,  $\text{CF}_3\text{CF}-\text{CF}_2$  and  $\text{CF}_3\text{C}=\text{O}$  can be used; they can be used singly or in combination of two or more. The chamber cleaning gas of the invention may be used in combination with a monomer gas such as He, Ne, Ar,  $\text{H}_2$ ,  $\text{N}_2$  or  $\text{O}_2$ .

There is no limitation on materials of the chamber. The chamber may be made of known materials such as stainless steel or aluminum alloy. Without adversely affecting the materials of the chamber, the chamber cleaning gas of the invention can quickly remove reaction byproducts attached to the wall of the chamber.

Examples of byproducts removed by the cleaning method of the invention are silicon, polysilicon, tungsten, titanium and their oxides, nitrides and

carbides.

As the chamber cleaning conditions of the invention, conventional conditions using perfluoro compounds may be used as they are.

5 All the three kinds of chamber cleaning gases of the invention have satisfactory levels of properties so that they can be used as substitutes for conventionally used chamber cleaning gasses, namely,  $\text{CF}_4$ ,  $\text{C}_2\text{F}_6$  and  $\text{SF}_6$ . Moreover, the gases of the invention have much lower  
10 global warming potential than  $\text{CF}_4$ ,  $\text{C}_2\text{F}_6$  and  $\text{SF}_6$ .

For example, when used under known chamber cleaning conditions (pressure = 100 m Torr; input high-frequency power = 300 W; gas flow rate = 50 cc/min) for 30 minutes,  $\text{CF}_3\text{CF}=\text{CF}_2$  of the invention fully and quickly  
15 removes attached byproducts from the chamber without damaging the chamber. Thus  $\text{CF}_3\text{CF}=\text{CF}_2$  of the invention is suitable for use in practice.

When  $\text{CF}_3\text{CF}(\text{O})\text{CF}_2$  is used in place of  $\text{CF}_3\text{CF}=\text{CF}_2$

20 under the above conditions,  $\text{CF}_3\text{CF}(\text{O})\text{CF}_2$  fully and quickly removes attached byproducts from the chamber without damaging the chamber, thus being usable in practice.

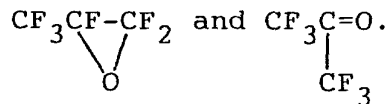
Similarly, when  $\text{CF}_3\text{C}(\text{O})\text{CF}_3$  is used in place of  
25

$\text{CF}_3\text{CF}=\text{CF}_2$ ,  $\text{CF}_3\overset{\text{CF}_3}{\underset{|}{\text{C}}}=\text{O}$  fully and quickly removes attached  
byproducts from the chamber without damaging the chamber,  
thus being usable in practice.

- 5           According to the present invention, chamber  
cleaning can be done satisfactorily, without using any of  
 $\text{CF}_4$ ,  $\text{C}_2\text{F}_6$ ,  $\text{C}_4\text{F}_8$  and  $\text{SF}_6$  that have extremely high global  
warming potential as compared with carbonic acid gas.

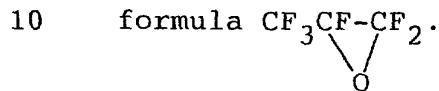
CLAIMS

1. A chamber cleaning gas comprising at least one gas selected from the group consisting of  $\text{CF}_3\text{CF}=\text{CF}_2$ ,



2. A chamber cleaning gas according to claim 1 comprising  $\text{CF}_3\text{CF}=\text{CF}_2$ .

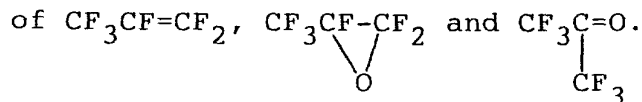
3. A chamber cleaning gas according to claim 1 comprising hexafluoropropylene oxide represented by the



4. A chamber cleaning gas according to claim 1 comprising  $\text{CF}_3\text{COCF}_3$ .

5. A chamber cleaning gas according to any one of  
15 claims 1-4 which further comprises at least one monomer gas selected from the group consisting of He, Ne, Ar,  $\text{H}_2$ ,  $\text{N}_2$  and  $\text{O}_2$ .

6. A chamber cleaning method comprising the step of  
treating a plasma CVD chamber of a semiconductor  
20 integrated circuit production device with at least one chamber cleaning gas selected from the group consisting of  $\text{CF}_3\text{CF}=\text{CF}_2$ ,  $\text{CF}_3\text{CF}-\text{CF}_2$  and  $\text{CF}_3\text{C}=\text{O}$ .



7. A chamber cleaning method according to claim 6  
25 wherein the chamber cleaning gas is  $\text{CF}_3\text{CF}=\text{CF}_2$ .



8. A chamber cleaning method according to claim 6 wherein the chamber cleaning gas is hexafluoropropylene oxide represented by the formula  $\text{CF}_3\text{CF}-\text{CF}_2$ .



5 9. A chamber cleaning method according to claim 6 wherein the chamber cleaning gas is  $\text{CF}_3\text{COCF}_3$ .

10 10. A chamber cleaning gas according to any one of claims 6-9 which further comprises at least one monomer gas selected from the group consisting of He, Ne, Ar, H<sub>2</sub>, N<sub>2</sub> and O<sub>2</sub>.

5

$\text{CF}_3\text{CF}(\text{O})\text{CF}_2$  and  $\text{CF}_3\text{C}(\text{O})\text{CF}_3$ , and provides a chamber cleaning

# DECLARATION FOR USA PATENT APPLICATION

(including Design and National Stage PCT)

Attorney's Docket ID: \_\_\_\_\_

## As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought

on the invention entitled CLEANING GAS

\_\_\_\_\_, the specification of which  
\_\_\_\_\_ is attached hereto. (or)

☒ was filed on July 9, 1997, [ ] and was amended on \_\_\_\_\_

[ ] as U.S. Application No. \_\_\_\_\_ (or)

[ X ] as International PCT Application No. PCT/JP97/02369

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 (a) - (d) or §365 (b) of any foreign application(s) for patent or inventor's certificate, or §365 (a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, where priority is not claimed, any foreign application for patent or inventor's certificate, or any PCT International application, having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s) (\_\_\_\_ ADDITIONAL APPLICATIONS IDENTIFIED ON ATTACHED SHEET):

| Number             | Country      | Day/Month/Year Filed | Priority Not Claimed |
|--------------------|--------------|----------------------|----------------------|
| <u>180518/1996</u> | <u>Japan</u> | <u>10/07/1996</u>    | _____                |
| _____              | _____        | _____                | _____                |

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or §365(c) of any PCT International application designating the U.S., listed below; and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application. (\_\_\_\_ ADDITIONAL APPLICATIONS IDENTIFIED ON ATTACHED SHEET.)

| Application Serial No. | Day/Month/Year Filed | Status - patented, pending, abandoned |
|------------------------|----------------------|---------------------------------------|
| _____                  | _____                | _____                                 |
| _____                  | _____                | _____                                 |

I hereby appoint the practitioners of LARSON AND TAYLOR associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to that Customer Number.

CUSTOMER NUMBER: 00881

Direct all telephone calls to \_\_\_\_\_, at TEL (703) 920-7200 (Fax: 703-892-8428)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

|  |  |             |                    |
|--|--|-------------|--------------------|
| Full Name of Sole or First Inventor                              | <u>ITANO Mitsushi</u>  | Citizenship | <u>Japan</u>       |
| Full Post Office Address   | <u>c/o Yodogawa Seisakusho, DAIKIN INDUSTRIES, LTD., 1-1, Nishihitotsuya, Settsu-shi, Osaka 566, Japan</u> |             |                    |
| Residence - City, State/Country (if different from P.O. address) | <u>Same as Post Office Address</u>   |             |                    |
| SIGN AND   |  |             |                    |
| DATE HERE:   | Inventor's Signature: <u>Mitsushi Itano</u>  | Date:       | <u>4 Nov. 1998</u> |

|  |   |
|--|---|
| Full Name of Second Joint Inventor, if any                       | Citizenship                             |
| Full Post Office Address   |   |
| Residence - City, State/Country (if different from P.O. address) |   |
| SIGN AND   |   |
| DATE HERE:   | Inventor's Signature: _____ Date: _____ |

|  |   |
|--|---|
| Full Name of Third Joint Inventor, if any                        | Citizenship                             |
| Full Post Office Address   |   |
| Residence - City, State/Country (if different from P.O. address) |   |
| SIGN AND   |   |
| DATE HERE:   | Inventor's Signature: _____ Date: _____ |

|  |   |
|--|---|
| Full Name of Fourth Joint Inventor, if any                       | Citizenship                             |
| Full Post Office Address   |   |
| Residence - City, State/Country (if different from P.O. address) |   |
| SIGN AND   |   |
| DATE HERE:   | Inventor's Signature: _____ Date: _____ |

SEE ATTACHED SHEET FOR SIMILAR INFORMATION AND SIGNATURE FOR ADDITIONAL JOINT INVENTORS.  
Law Offices of LARSON AND TAYLOR, 727 23rd Street South, Arlington, Virginia 22202